especially fit to be entrusted with their own freedom. It is likely that an enlightened society can be relied on to recognize this; but it is particularly the duty of the universities, if they believe in their own best traditions, to speak with no uncertain voice. We look chiefly to them for progress in those fundamental fields of knowledge which ultimately concern more intimately than any others the future of civilization; and if they are to continue their leadership they must show that they value above all immediate advantages the tradition of academic freedom.

Ralph S. Lillie

Clark University,
February 1, 1914

THE NATIONAL ACADEMY OF SCIENCES

The Academy will hold its annual meeting at Washington on April 19, 20, 21, 1915. The program is as follows:

MONDAY, APRIL 19

10 A.M.—Business meeting of the Academy in the Oak Room of the Hotel Raleigh.

1 P.M.—Luncheon in the private dining-room of the Hotel Raleigh.

2.30 P.M.—Auditorium, National Museum. Public scientific session:

Thomas H. Morgan: "Localization of the Hereditary Material in Germ Cells." (30 minutes.)

Problems of Nutrition and Growth:

Jacques Loeb: "Stimulation of Growth." (30 minutes.)

Lafayette B. Mendel: "Specific Chemical Aspects of Growth." (30 minutes.)

Eugene F. Du Bois, medical director, Russell Sage Institute of Pathology (by invitation of the program committee): "Basal Metabolism during the Period of Growth." (30 minutes.)

I. S. Kleiner and S. J. Meltzer: "Retention in the Circulation of Injected Dextrose in Depancreatized Animals and the Effect of an Intravenous Injection of an Emulsion of Pancreas upon this Retention." (10 minutes.)

5 P.M.—Meeting of the editors of the *Proceedings*, Cosmos Club.

8 P.M.—Auditorium, National Museum.

First William Ellery Hale Lecture, by Thomas Chrowder Chamberlin, of the University of Chicago. Subject: "The Evolution of the Earth." (Illustrated.)

The lecture will be followed by a conversazione in the Art Gallery of the National Museum.

TUESDAY, APRIL 20

10 A.M.—Auditorium, National Museum. Public scientific session:

Joel Stebbins, Draper Medallist: "The Electrical Photometry of Stars." (30 minutes, illustrated.)

George E. Hale: "A Vortex Hypothesis of Sun Spots." (20 minutes, illustrated.)

Edwin B. Frost: "The Spectroscopic Binary, Mu Orionis." (10 minutes, illustrated.)

Robert W. Wood: "One-dimensional Gases and the Experimental Determination of the Law of Reflection for Gas Molecules." (10 minutes, illustrated.)

Robert W. Wood: "The Relation between Resonance and Absorption Spectra." (15 minutes, illustrated.)

Edward L. Nichols and H. L. Howes: "On the Polarized Fluorescence of Ammonio-Uranyl Chloride." (15 minutes, illustrated.)

Robert A. Millikan (by invitation of the Program Committee): "Atomism in Modern Physics." (30 minutes, illustrated.)

1 P.M.—Luncheon in the Oak Room of the Hotel Raleigh.

2.30 P.M.—Auditorium, National Museum. Public scientific session:

William Morris Davis: "Problems Associated with the Origin of Coral Reefs, suggested by a Shaler Memorial Study of the Reefs of Fiji, New Caledonia, Loyalty Islands, New Hebrides, Queensland and the Society Islands, in 1914." (60 minutes, illustrated.)

F. W. Clarke: "Inorganic Constituents of Marine Invertebrates." (15 minutes.)

Roy L. Moodie (introduced by Henry Fairfield Osborn): "Amphibia and Reptilia of the American Carboniferous." (15 minutes, illustrated.)

Henry Fairfield Osborn and J. Howard McGregor: "Human Races of the Old Stone Age of Europe, the Geologic Time of their Appearance, their Racial and Anatomical Characters." (15 minutes, illustrated.)

Charles A. Davis, geologist, Bureau of Mines (by invitation of the Program Committee): "On the Fossil Algæ of the Petroleum-yielding Shales of the Green River Formation." (15 minutes, illustrated.)

Nathaniel L. Britton: "The Forests of Porto Rico." (10 minutes.)

J. Walter Fewkes: "Pictures on Prehistoric Pottery from the Mimbres Valley in New Mexico, and their Relation to Those of Casas Grandes." (20 minutes, illustrated.)

Charles B. Davenport: "Inheritance of Temperament." (15 minutes.)

Charles B. Davenport: "Inheritance of Huntington's Chorea." (12 minutes.)

8 P.M.—Annual dinner of the members of the Academy and their guests and presentation of the Draper medal, held in the Oak Room of the Hotel Raleigh.

WEDNESDAY, APRIL 21

10 A.M.—Oak Room, Hotel Raleigh.

Business meeting of the Academy for the election of members and two members of the council.

1.30 P.M.—Luncheon in the private dining-room of the Hotel Raleigh.

2.45 P.M.—Auditorium, National Museum.

Public scientific session. George H. Parker, official representative of the academy upon the Special Commission appointed by the President of the United States to study and report upon the Alaskan fur seals during the summer of 1914. Subject: "The Fur-Seal Herd of the Pribilof Islands." (Illustrated.)

4 P.M.—Auditorium, National Museum.

Second William Ellery Hale Lecture, by Thomas Chrowder Chamberlin, of the University of Chicago. (Open to the public.) Subject: "The Evolution of the Earth." (Illustrated.)

JACQUES LOEB: *Stimulation of Growth.*

The speaker intends to discuss the stimuli which induce development and growth in three cases.

1. *Artificial parthenogenesis,* or the nature of conditions which cause the egg to develop. It has been shown that all substances which cause a cytolysis of the surface layer of the egg start the development; and that the spermatozoon must contain a substance of that character; but that in addition a second treatment is required to insure a more normal development. The alteration of the surface layer increases the rate of oxidations in the egg by 400 to 600 per cent. and the same effect is produced by the entrance of the spermatozoon into the egg.

It seems that under certain conditions this alteration of the surface is reversible and it is inferred but not yet proven that in this case the acceleration of the rate of oxidations is reversed. This reversibility is a fundamental fact, since the alteration of conditions of active growth and rest are a prerequisite for the continuity of life.

2. *Metamorphosis.* Phenomena of growth occur in the larval metamorphosis when certain organs disappear and new ones begin to grow. A number of facts have indicated that substances circulating in the blood are responsible for these phenomena of growth and this conclusion was put on a permanent basis by the discovery of Gudernatsch that it is possible to induce in tadpoles at any time the outgrowth of legs and complete metamorphosis by feeding them with thyroid.

3. *Regeneration.* By regeneration we mean the phenomena of growth started by the removal of some part. It can be shown that in these cases also the growth is induced by the collection of (probably specific) substances at places where they could not gather under normal conditions.

LAFAYETTE B. MENDEL: *Specific Chemical Aspects of Growth.*

A review of the methods employed in the investigation of chemical problems of growth. Analysis of the tissues of growing individuals has failed to contribute much of specific importance, owing to the tendency of the body to maintain a fixity of composition under varying conditions of diet. The study of nutrition in growth is more profitable. This has involved a determination of the constructive units essential for the building up of an adult organism. Recent contributions respecting the rôle of the individual nutrients, and particularly the proteins, are considered. The part played by the amino acids derived from proteins in digestion has been investigated. Some of these can be synthesized in the organisms; others apparently can not, and must be furnished in some form in the dietary. The newer researches suggest that in addition to the familiar foodstuffs certain as yet undetermined food accessories (also called "vitamines") are needed. The evidence for this view and the facts regarding the existence of special chemical determinants of growth are discussed.

EUGENE F. DU BOIS: *The Basal Metabolism during the Period of Growth.*

In order to compare the basal metabolism of children with that of adults it is best to use as a basis the calories per square meter of body surface per hour. The average figure for men is 34.7 calories with a plus or minus variation of 10 per cent. For a short time after birth the average for infants is 20 per cent. below this figure. The metabolism then rises rapidly and reaches a point 50 per cent. above the adult level at the age of 2 years, remaining at this height until the age of 6

years, then falling steadily until the age of 19. From this point there is very slight decrease before old age is reached. During convalescence from typhoid fever the curve of metabolism is similar to that of childhood. The evidence points towards an increased metabolism of growing tissue. The fact that the liver and thyroid gland are relatively large in children may account for part of the increase.

I. S. Kleiner and S. J. Meltzer: *Retention in the Circulation of Injected Dextrose in Depancreatized Animals and the Effect of an Intravenous Injection of an Emulsion of Pancreas upon this Retention.* Preliminary communication. Presented by S. J. Meltzer.

When dextrose is injected intravenously into normal animals, even in large quantities, it disappears rapidly from the circulation, and the sugar content of the blood is, in a short time, quite normal again. In previous investigations the authors found that in depancreatized dogs there is a tendency for the circulation to retain for a longer period a part of the injected dextrose. In recent experiments it was further found that, when with the infusion of dextrose in depancreatized dogs an emulsion of pancreas is simultaneously injected, the circulation seems to lose its power to retain the injected dextrose. These experiments seem, therefore, to show that the power of the circulation to rid itself of a surplus of sugar is due to the influence of an internal secretion of the pancreas.

R. A. Millikan: *Atomism in Modern Physics.*

Atomism in modern physics begins with Dalton's discovery in 1803 of exact multiple relationships between the combining powers of the elements. Out of this discovery grew the whole of modern chemistry. The second tremendously important step was taken in 1815 when Prout pointed out that the atomic weights of the lighter elements appeared to be exact multiples of that of hydrogen, thus suggesting that hydrogen was itself the primordial element. The periodic table of Mendeleef added support to such a point of view, and Mosley's recent brilliant discovery through the study of X-ray spectra of a new series of multiple relationships, represented by a consecutive series of atomic numbers from 13 up to 79 with every number except three corresponding to a known element, is another most significant bit of evidence. When we add to this three other facts, namely, (1) that each member of a radioactive family, like the uranium family, has been definitely shown to be produced from its immediate ancestor by the loss by that ancestor of one atom of helium (which is almost equal in weight to four atoms of hydrogen), (2) that in an atomic weight table the differences between the weights of adjacent elements are in almost every case exact multiples of the weight of the hydrogen atom, the characteristic helium difference 4 appearing with extraordinary frequency, and (3) the fact that the introduction of the concept of electro-magnetic mass, and the consequent discovery of the inconstancy of mass, open several ways of explaining the slight departures in the exactness of the multiple relations between atomic weights pointed out by Prout, it will be evident that modern science may well feel fairly confident that it has indeed found in hydrogen the primordial atom which enters into the structure of all the elements. All this is merely a very modern verification of very ancient points of view.

But modern physics has recently taken a more significant and more fundamental step than this, for it has looked inside the atom with the aid of X-rays and other ionizing agents, and has there come upon electrically charged bodies, whose inertia or mass is wholly accounted for, at least in the case of the negative elements, by their charges. This discovery marks the fusing into one another of two streams of physical investigation, namely, the molecular stream and the electrical stream. A necessary condition for the justification of this last step was the bringing forward of indubitable proof that the thing which has heretofore been called electricity is after all, contrary to Maxwell's view, a definite material substance in the sense that it exists in every charge in the form of discrete elements; in other words, that it too like matter is atomic or granular in structure. Such proof was found in the discovery in the oil drop experiments of even more exact multiple relationships between all the possible charges which can be put on a given body than Dalton had ever discovered between combining powers or Prout between atomic weights or Moseley between X-ray frequencies. The greatest common divisor of this series of charges is then the ultimate unit or atom of electricity which has been named the "electron." New evidence that it is indeed a universal and invariable natural constant will be brought forward and a new determination of its value will be presented.

It is obvious that as soon as we could assert that these electrons are found in the hydrogen atom it was necessary to suppose that a single hydrogen atom contains at least two such electrons, one positive and one negative, and as a matter of

fact the evidence is now strong that it consists of exactly two. This twentieth century has then discovered for the first time a new subatomic world of electrons, the constituents of atoms.

All this is definite and probably permanent. But atomic conceptions in more or less vague form have also begun to invade the one remaining field of physical investigation, namely, the field of ethereal radiations. The most significant of recently discovered facts in the domain of radiant energy are these:

(1) Ethereal radiations when absorbed by matter, if they are of high enough frequency, will detach one and only one electron from a single atom. (2) The energy transferred to this electron from the ether wave is independent of the intensity of the incident radiation. (3) It is also independent of the kind of matter from which the electron is taken, but (4) it is exactly proportional to the frequency of the ether wave which detaches it.

These facts are stated in an equation set up tentatively by Einstein in 1905, and arrived at by him from the standpoint of a modified corpuscular theory of radiation. New proofs of the exactness of Einstein's equation will be presented and the evidence for and against Einstein's conception will be discussed. Whether the conception ultimately stands or falls, it appears probable, at any rate, that an equation has been obtained which is to be of no less importance in future physics than Maxwell's equation of the electro-magnetic field, and which seems destined to unlock for the physicists of the future the doors to the understanding of the relations existing between matter and radiant energy.

W. M. DAVIS: *Problems Associated with the Origin of Coral Reefs suggested by a Shaler Memorial Study of the Reefs of the Fiji, New Caledonia, Loyalty Islands, New Hebrides, Queensland and the Society Islands.* (Illustrated.)

The sea-level coral reefs of the Pacific are singularly non-committal as to their origin. The visible reefs accommodate themselves indifferently to any one of the eight or nine theories invented for their explanation. Hence a choice among the theories must be guided not so much by a study of the reefs themselves as by a study of associated phenomena, which thus gain an unexpected importance in coral reef investigation. It is because the associated phenomena have been insufficiently studied that so many contradictory theories have found favor. Of all associated phenomena, those provided by the central islands within barrier reefs are the most accessible and the least equivocal; next in importance are those offered by uplifted and dissected reefs. It will be shown by means of landscape views and theoretical diagrams that no theory accounts for all the facts—those of the associated phenomena as well as those of sea-level reefs—so well as Darwin's original theory of subsidence; and that the strongest confirmation of Darwin's theory is given by the embayments of the central islands within barrier reefs, as was long ago pointed out by Dana. Thus the results now reached regarding the reefs of the Pacific agree with the conclusions announced in recent years by several Australasian observers. It is believed that the several alternative theories advocated by various investigators during the last thirty-five years will be given up, and that Darwin's theory of subsidence will regain the general acceptance that it formerly enjoyed (1840–80).

GEORGE E. HALE: *Some Vortex Experiments on the Motion of Sun-spots.*

A closely wound helix of brass wire, with circular disks threaded on it, is hung vertically in water and spun at high velocity. The columnar vortex thus formed gradually changes into a semicircular vortex ring, by the rise of the lower end of the helix until it meets the surface. Thus the second sun-spot in a typical bipolar group might be formed by the turning up of the columnar vortex assumed to constitute a single spot. Preliminary rotation of the whole mass of liquid retards or prevents the turning up process if in the same direction as that of the helix, and hastens it if in the opposite direction. Hence, a persistent single spot may represent a rotating gaseous column whose diameter is large in comparison with its length.

Circular or semicircular vortices have a proper motion at right angles to their planes, in the direction of motion of the inner edge of the whirling ring. As high and low latitude bipolar spots rotate in opposite directions, they should, therefore, move toward the pole and the equator, respectively. Carrington's observations show this to be the case. The velocity to be expected is being determined by measuring the velocity of vortex rings in liquids and compressed gases. Observations of the stream-lines of ionized smoke particles, above single and double magnetic vortices representing sun-spots, are also in progress.

F. W. CLARKE: *The Inorganic Constituents of Marine Invertebrates.*

Essentially a report of progress. The object of the investigation is to determine, more systematically than has been done hitherto, just what each

group of organisms contributes to the marine sediments, and therefore to the formation of marine limestones and especially to their magnesian and phosphatic varieties. The work is practically complete as regards the true corals, the mollusks, the brachiopods and the echinoderms. The inorganic constituents of the corals and mollusks are mainly calcium carbonate, with insignificant impurities. The echinoderms are all more or less magnesian, their skeletons containing from 6 to 14 per cent. of magnesium carbonate. The brachiopods fall into two groups, the shells of one group being mainly calcium carbonate with little organic matter; while those of the other group are essentially calcium phosphate with much organic matter. Work is yet to be done on the foraminifera, the coralline hydrozoans, the bryozoans, sponges and crustaceans. Some of the results so far obtained are novel, others merely confirm the older recorded observations.

Charles A. Davis: *On the Fossil Algæ of the Petroleum-yielding Shales of the Green River Formation.*

The Green River shales of Eocene age are known from northwestern Colorado, west into Utah and north into Wyoming. In places they are more than 3,000 feet thick. They are usually hard, tough, compact and fine-grained and brown in color, but weather to light gray or whitish. Certain beds are highly carbonaceous, burn freely and appear like lignite. Freshly broken surfaces give off a bituminous odor but never appear oily; when heated in closed retorts, petroleum passes off among the distillates.

By special treatment this shale has been sectioned to any desired thinness with a microtome. Microscopic examination of such sections from samples yielding abundant petroleum on distillation, shows the shale to be composed largely of organic matter, chiefly of vegetable origin, as well-preserved plant remains are common.

The most conspicuous plants observed are microscopic algae, which are very numerous in the slides so far studied.

The discovery of a very considerable algal flora in this great and but slightly altered series of petroleum-yielding shales is of especial interest because of the light it may throw on the origin of petroleum and related compounds.

(A few lantern slides from microphotographs of fossil algæ from the shales will be shown.)

J. Walter Fewkes: *Pictures on Prehistoric Pottery from the Mimbres Valley in New Mexico, and their Relation to those of Casas Grandes.*

The unexpected discovery near Deming, New Mexico, of an exceptionally large number of vessels, made of earthenware, decorated with paintings of mythic animals and men, has led to an enlarged knowledge of the prehistoric culture of our southwest. These pictures, unknown a year ago, have been found in great abundance, and are highly characteristic. Those representing men engaged in various occupations are particularly valuable in the light they throw on ancient manners and customs.

These pictures were painted by a people antedating the nomads found in the Mimbres Valley by the first white visitors, and who disappeared before the beginning of the historic epoch. The pictures have archaic characteristics that point to a remote antiquity as compared to that on modern pueblo pottery.

The cause of the disappearance of this culture from the Mimbres Valley can be traced to local influences rather than to widespread modifications of climate. One of the important local causes of the abandonment of the prehistoric settlements when they were found, was a change in the course of the river.

The geographical isolation of the Mimbres Valley has played an important rôle in developing the peculiar culture these pictures express, while its north and south extension has facilitated interchanges of cultures leading to far-reaching resemblances in these directions.

C. B. Davenport: *Inheritance of Huntington's Chorea.*

Huntington's chorea is a name applied to a group of symptoms first brought together as an entity by Dr. George S. Huntington. The traits involved are four: (1) persistent tremors over a less or greater part of the body; (2) their onset in middle or late life; (3) their progressive nature, and (4) a progressive mental deterioration. Analysis of many chorea-bearing fraternities shows that this supposed neuropathic entity is really only a syndrome inasmuch as, in the choreic families, mental deterioration may appear without tremors, the tremors may progress without mental symptoms, the mental symptoms may not progress and the onset of the disease may be in early life. Indeed, an analysis of families reveals the presence of biotypes characterized by specific forms of choreic involvement and progression. In the inheritance of the elements of the syndrome the choreic movements are clearly a dominant trait; some of the elements of the mental condition (which is usually allied to manic-depressive insanity) are also dominant. The law of anticipation in successive generations

in the age of onset is shown probably to have a merely statistical significance.

C. B. DAVENPORT: *Inheritance of Temperament.*

An analysis of matings between persons who have a prevailingly elated and those who have a prevailingly depressed temperament indicates that the temperament of the former is inherited as a simple dominant, that of the latter as a recessive, but not allelomorphic to elation. In F_2 and later generations the zygotic combinations are complex, including elated, depressed, alternating, normal and intermediate grades. Thus with a knowledge of ancestry sufficient to infer the gametic composition of the parents the distribution of temperaments for the offspring may, within limits, be predicted.

G. H. PARKER: *The Fur-seal Herd of the Pribilof Islands.*

The Alaskan fur-seals are pelagic animals that, during the summer, come ashore on the Pribilof Island for the purpose of breeding. The adult males, or bulls, arrive on the islands in May and June followed by the females, or cows. A bull may have associated with him from one to over a hundred cows, and this assembly constitutes a harem. Each cow, shortly after her arrival, gives birth to one young seal, or pup, and soon thereafter becomes again pregnant. The period of gestation is a little less than a year. The seals in the main leave the islands for the open sea early in the autumn. In 1914 there were born on the Pribilof Island over 93,000 seals and the total herd was estimated to be slightly under 300,000, a fair increase over the former year. As there are about equal numbers of males and females born and as the average harem is composed of one male and about sixty females, there are under normal conditions a considerable number of excess males, the so-called idle bulls. The number of idle bulls is a measure of the lack of adaptation in the proportion of sexes and indicative of a certain inefficiency on the part of nature.

ARTHUR L. DAY,
Home Secretary
SMITHSONIAN INSTITUTION,
WASHINGTON, D. C.

EBERHARD FRAAS

FROM Stuttgart comes the very sad news of the death upon March sixth of the very distinguished paleontologist, Dr. Eberhard Fraas, professor in the university and head of the Royal Museum of Natural History. On the very day following, namely, March 7, the widow of Professor Fraas learned of the death of their only son, Hans Oscar Fraas, in the Argonne near Vauqois, on March 1. The young man was twenty-two years of age.

Eberhard Fraas was one of the most talented pupils of Karl von Zittel, at Munich, and was one of the ablest and broadest of the vertebrate paleontologists of Europe. Besides his explorations, chiefly in the marine and terrestrial Trias and Upper Permian of Württemberg, he traveled widely through other parts of Europe, and made an extensive journey accompanied by the writer through the Jurassic-Cretaceous exposures of the Rocky Mountain region. It was, however, his journey to the dinosaur beds of German East Africa some years ago which very seriously impaired his health and necessitated one or two surgical operations from which he never fully recovered, so that although a man of superb physique his death came at the early age of fifty-two.

He leaves as his monument great collections of vertebrate fossils, especially in the museum at Stuttgart, including the phytosaurs and carnivorous dinosaurs of the Trias and many of the very early and most rare of the Testudinata besides a superb collection of ichthyosaurs from Holzmaden, which he was the first to describe, and of the marine Crocodilia from the Jura.

Among the most important of his early contributions were those to the Labyrinthodonts and other giant Stegocephalia of the Permian. Among his latest was the description of the carnivorous dinosaurs of the Trias as well as the geological narrative of the journey to East Africa. All his papers are enlivened by a keen appreciation of the importance of adaptation and of the adaptive significance of the various types of structure, one of his principal contributions in this line being his interpretation of the adaptive evolution of the ichthyosaurs from terrestrial to aquatic life, which was facilitated by the study of his unrivaled collections.

His death is a loss not only to the Fatherland but to the whole world of vertebrate pale-